PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G02B 6/44 — A1

(11) International Publication Number: **WO 99/47960**

(43) International Publication Date: 23 September 1999 (23.09.99)

(21) International Application Number: PCT/GB99/00643

(22) International Filing Date: 3 March 1999 (03.03.99)

(30) Priority Data:
9805757.3 18 March 1998 (18.03.98) GB

(71) Applicant *(for AT BE BR CA CH CN CY DE DK ES FI FR GB GR ID IE IL IN IT JP KR LU MC MX NL PL PT RU SE TR only)*: N.V. RAYCHEM S.A. [BE/BE]; Diestsesteenweg 692, B–3010 Kessel–Lo (BE).

(71) Applicant *(for MG only)*: RAYCHEM LIMITED [GB/GB]; Faraday Road, Dorcan, Swindon, Wiltshire SN3 5HH (GB).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: WAMBEKE, Alain [BE/BE]; Solveld 32, B–3440 Zoutleeuw (BE).

(74) Agent: JAY, Anthony, William; Raychem Limited, European Patent Dept., Faraday Road, Dorcan, Swindon, Wiltshire SN3 5HH (GB).

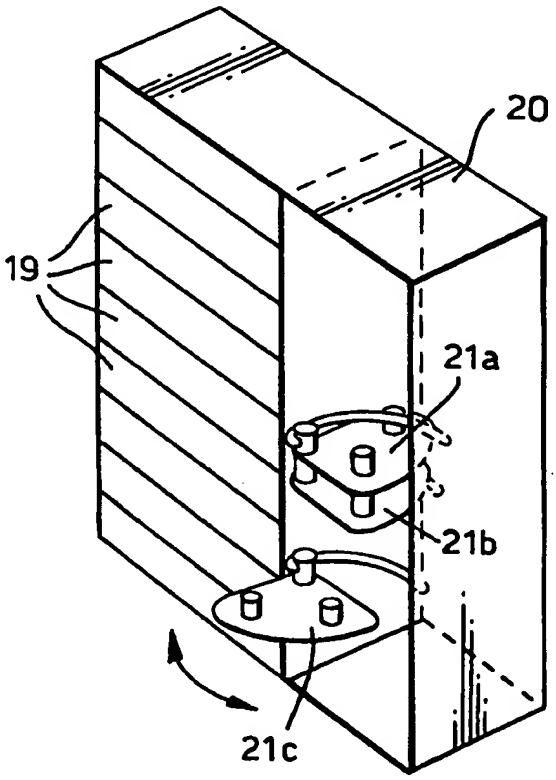
(81) Designated States: BR, CA, CN, ID, IL, IN, JP, KR, MG, MX, PL, RU, TR, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: OPTICAL FIBRE OVERLENGTH STORAGE

(57) Abstract

An optical fibre connection and storage system comprising a plurality of connection cabinets provided with means for the connection or splicing of a first plurality of fibres to a second plurality of fibres and a plurality of respective storage means for the storage of overlength of the second plurality of fibres, wherein each of the plurality of cabinets has associated with but separate from it one of the plurality of storage means, with each storage means being provided for the storage of the overlength of the second plurality of fibres from a single respective cabinet.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

OPTICAL FIBRE OVERLENGTH STORAGE

This invention relates to fibre optic management systems or distribution centres and in particular to storage means for excess lengths of optical fibre and in particular excess lengths of so-called fibre optic pigtail in such systems and centres.

Cable management in fibre optic systems is particularly important because of the nature of the optical fibres themselves. Fibre optic cable being formed of glass fibres has a limited range of bending and must be maintained above a minimum bend radius during use and storage. Excessive bending can lead to impaired transmission and if severe could lead to transmission loss. Fibre optic management systems or distribution centres, therefore, need to be designed to minimise fibre optic impairment or damage by properly supporting the cables along predetermined paths and protecting them from bends sharper than a given minimum bend radius. In addition the number of optical fibres within management systems or distribution centres is constantly increasing and even simple systems have a high density of optical fibres. It is necessary to house and organise the optical fibres and their connections in an efficient manner to avoid excessive installation and/or repair times. The individual fibre optic cables also need to be readily identifiable and accessible at all times. Additional problems in organisation and storage occur due to the need for the installation to allow for modification and expansion. It is, therefore, necessary to leave excess or spare lengths of cabling for such further modification and expansion and the management systems or distribution centres must provide means of storing that excess or overlength of cable.

Generally in a fibre optic management system or distribution centre optical fibres originating from a main or trunk cable are directed into a series of connection cabinets which are usually stacked one on top of each other to form a rack. Within the connection cabinets the optical fibres are modified as required for their further purpose. Generally they will be connected in some way to a further optical fibre, e.g. by splicing or by a mechanical connector. In the industry the further optical fibre may be called by one of a variety of names depending on the means of connection at its terminal ends. A fibre optic having a fusion splice at one end and a mechanical connector at the other end is generally referred to as a "pigtail", whereas one having a mechanical connector at each end is generally referred to as a "jumper" or a "patch cord". In the following description and claims the term pigtail will be used to refer to any interconnecting optical fibre so that it covers pigtails, jumpers and patch cords as defined above. To allow for future modification and storage it is required to leave for each connection cabinet a length of slack pigtail, which may be several metres long. Storage of that length of pigtail slack presents a specific problem. In known distribution racks the pigtail slack for each connection cabinet is jumbled together with that from all of the other connection cabinets in the rack, for example at the sides of the cabinets. As there are commonly hundreds or even thousands of pigtails per distribution rack the problem of the combined jumble of pigtail slack is clear.

There is therefore a need to improve the storage of pigtail slack in a management system or distribution centre which allows for ready access and identification of individual fibres whilst at the same time protecting them from harmful bending or other damage.

According to the present invention there is provided an optical fibre connection and storage system comprising a plurality of connection cabinets provided with means for the connection or splicing of a first plurality of fibres to a second plurality of fibres and a plurality of respective storage means for the storage of overlength of the second plurality of fibres, wherein each of the plurality of cabinets has associated with but separate from it one of the said plurality of storage means, with each storage means being provided for the storage of the overlength of the second plurality of fibres from a respective cabinet.

The second plurality of fibres may be a plurality of pigtail fibres.

The storage means is such as to be able to store all of the slack or excess fibre, e.g. pigtail, necessary for the connection cabinet with which it is associated. It is preferably provided with means of efficiently organising the stored fibre. For such purpose the storage means may have a main body or tray extending out from which is provided at least one optical fibre guide member such as a spool. Such a member or spool can be integrally moulded to the main body or be engageable therewith e.g. with a snap engagement. More than one guide member or spool may be provided so as to minimise the amount of fibre it is required to wind around any one guide member or spool.

In conventional fibre or cable storage means the fibres are organised, i.e. directed and guided, around guide members or spools in a single two dimensional plane. It has been found to be advantageous to provide means for locating the stored fibres in three dimensions to increase the degree of organisation within the storage means. The means for spatially organising the stored fibres in three dimensions should be capable of guiding

fibres away from the general plane in which they are lying. Where, for example, the stored cables lie generally in a first plane the spatial organisation means directs the fibres out of that plane in a direction inclined away from that plane. If the first plane is substantially horizontal it may direct the fibres, for example, upwards in a generally vertical direction. The so guided fibres may be further stored on another plane at a distance from the horizontal base plane.

The use of means for spatially organising stored fibres or cables in three dimensions is not limited to use within a system according to the present invention. It could be used in any situation requiring the storage of cable. Accordingly, there is further provided optical fibre or cable storage means having a main body, at least one fibre or cable storage member positioned on the main body and on which fibre or cable can be guided and stored and means of spatially organising the fibre or cable in three dimensions.

Preferably the means of spatially organising the stored fibres in three dimensions takes the form of a fibre guide or arm shaped so as to be able to direct the fibres spatially as required. In general the fibre guide should be shaped so as to be able to direct fibres away from one plane to another, distanced plane. The two planes may be substantially parallel to each other. The fibre guide is preferably movably mounted with respect to the main body of the storage means. It is preferably movable from a first storage position to a second access position in which access to all parts of the stored fibre is facilitated. The means by which the fibre guide is movably mounted may take any suitable form, but preferably allows the fibre guide to be swung or pivoted away from the storage means or at least the main body of the storage means. The fibre guide may, for example, be

mounted about a pivot pin or hinge provided on the main body.

The storage means itself may also be movable with respect to the rack or system in which it is to be used and in particular with respect to the connection cabinet with which it is associated. Where the storage means is not fixedly secured within the system the whole storage means may be independently moved in any way desired, but where it is fixedly attached the attachment means needs to be adapted to allow relative movement. That relative movement may take any desirable form such as translation, rotation etc. It is preferred that the storage means be pivotally mounted with respect to the connection cabinet with which it is associated. In cases where a relatively movable fibre guide is provided the axis of pivoting of the storage means may be the same as that around which the fibre guide pivots, i.e. they may be both mounted about the same pivot post, pin or screw which passes through mountings on each relatively movable component. Where the storage means is relatively movable it should be shaped, e.g. its main body should be shaped, so as to be able to move easily from a first storage position to a second access position within the space provided, e.g. it may be provided with suitably shaped, possibly rounded edges.

The storage means may be provided with means for mounting it fixedly with regard to the rack or system in which it is to be used, e.g. on a shelf within such a system. It may additionally or alternatively be provided with means for attachment to the connection cabinet to which it is associated. A variety of means of effecting that mounting are possible and will be well known to the skilled man. Any attachment means may be separate from or integral with any means provided for allowing relative movement of the

connection cabinet and storage means.

The optical fibre connection and storage system of the present invention could be used on its own or within a conventional system, i.e. with other connection cabinets where fibre overlength is not individually stored.

Where desired or required an individual storage means could be provided for the overlength of each splice tray or connector tray in the cabinet. Such provision, however, increases the expense of the system and may not be necessary in all cases.
The means for connection or splicing of the first and second plurality of fibres within the connection cabinet can take any suitable form and will be well known to the skilled man. Examples include mechanical connector trays or a patch panel for mechanical connectors and/or fusion splice trays; the choice depending on the requirements of the user.

For additional support and protection of the fibres means are also preferably provided for guiding and supporting the fibres as they leave the storage means. Such means may take the form of an outlet guide having a guide channel through which the fibres longitudinally pass. Although it is desirable to surround the fibres passing through the outlet guide, i.e. to enclose them on all sides to provide maximum protection, it is advantageous to be able to remove the fibres from the outlet guide without requiring their disconnection at one end. For this purpose the outlet guide can be provided with a passageway allowing for the lateral removal and entry of guided fibres. Means may be provided for closing off the passageway as required. The outlet may be provided with means of transposing it from a closed protection position to an open access position. A part of the outlet guide may be

movable to allow fibres to be passed out through the outlet guide. As an example a wall or part of a wall of the outlet guide may be so movable. Alternatively the outlet guide may be provided with one component having a passageway extending through one of its walls which corresponds with a similar passageway provided on another component of the outlet guide to which it is relatively movable. The passageway is fully open allowing fibres to be passed out of the outlet guide when the two components are properly aligned but is closed without such alignment.

The outlet guide may be a separate or integral component of the storage means. Further, it could be associated with the means of spatially guiding the stored fibre in three dimensions, e.g. it could be mounted on one end thereof.

In a particularly useful embodiment of the present invention the connection cabinet and overlength storage means are provided as an integral module. Individual modules can then be stacked upon each other to form a rack. The present invention provides such a module.

In addition the invention provides a storage means for use in an optical fibre connection and storage system according to the present invention.

The present invention is advantageous as it solves the problem of organisation of fibre, e.g. pigtail, overlength during storage. The present invention solves that problem by storing and organising excess fibre for each cabinet in a rack separately from those of all the other cabinets. Further, means are provided by which orderly storing of the fibre is effected. With the provision of relatively movable components ease of access and

identification of individual fibres is facilitated. The present invention allows for short dismantling times, good minimum bend radius control, and easy and fast installation, using modular units where desired. The high degree of organisation of stored excess fibre facilitates tracing and handling of a single fibre. In embodiments where not only the overlength storage means can move with respect to the system but a spatial fibre guide is provided which is movable independently with respect to the storage means maximum access to fibre overlength is achieved.

For a better understanding of the present invention and to show how the same may be put into effect, reference will now be made, for the purposes of illustration only, to the accompanying drawings in which:

Figure 1 is a schematic perspective view of one embodiment of an optical fibre connection and storage system according to the present invention shown in a first position;

Figure 2 is the embodiment of Figure 1 shown in a second position;

Figure 3 is a perspective schematic view of an embodiment of a pigtail overlength storage means for use in the present invention;

Figure 4 is an enlarged exploded view of part of the embodiment shown in Figure 3;

Figure 5 shows a perspective view of a connection and storage system according to the present invention; and

Figure 6 shows a schematical front elevational view of a connection and storage system according to the present invention.

In Figure 1 there is shown a connection cabinet 1 and associated pigtail overlength storage

means 2 for use in a connection and storage system according to the present invention. The connection cabinet 1 is substantially identical to conventional cabinets used for the connection or splicing of optical fibres. The pigtail overlength storage means 2 has a main body 3 which forms a base plate from which two upstanding cylindrical spools 4 extend. The main body 3 is provided with a front 5 and back 6 retaining wall. The main body 2 is attached to the connection cabinet 1 via mounting bracket 7 which forms a shelf on which the storage means 2 rests. The main body 3 is hingedly mounted on that mounting bracket 7 so as to be pivotable about that bracket 7. The pigtail overlength storage means 2 is provided with a guide arm or trunk 8 which is pivotally mounted at one end 9 with respect to the main body 3. The guide arm 8 takes the form of a substantially U-shaped guide channel.

In use a fibre optic cable 10 enters the connection cabinet 1 is connected or spliced therein to a fibre optic pigtail (not shown). Excess of that pigtail is stored after exiting from the connection cabinet 1 by being wound around the spools 4 provided on the main body 3 in a substantially horizontal plane. The excess fibre is then vertically guided up out of that plane through the U-shaped channel of the guide arm 8. To facilitate access to stored pigtail overlength the main body 3 can be pivotally moved out from its stored position shown in Figure 1 to its access position shown in Figure 2 in which access to the stored pigtail is facilitated. Improved access is further achieved when the guide arm 8 is also pivoted relative to the main body 3 as shown in Figure 2.

In the close-up view shown in Figures 3 and 4 a further embodiment of a pigtail overlength storage means is illustrated in detail. The storage means takes the form of a pigtail overlength storage tray 11. It is provided with a guide trunk 12 which is movable

in relation to the storage tray 11. For attachment to a connection cabinet (not shown) a mounting bracket or shelf 13 is provided with a hollow, upstanding boss 14 (Figure 4) around which a pivoting bracket 15 provided on the storage tray 11 can be fitted. The dimensions of the boss 14 and pivoting bracket 15 are such as to allow the storage tray 11 to be pivoted with respect to the mounting bracket 13. The guide trunk 12 is provided at one end, the end by which it is mounted, with a cylindrical pin or plug 16 which fits within the hollow mounting boss 14. The dimensions are again chosen so that the guide trunk 12 can be pivoted within the boss 14. The guide trunk 12 is provided at its other end with an outlet guide 17 with outwardly tapering walls. A passageway 18 is provided to allow the side entry and exit of fibres from the guide trunk 12 without requiring their disconnection.

In Figure 5 a plurality of connection cabinets 19 are shown stacked vertically one on top of the other within a rack 20. Three pigtail overlength storage units 21a, b, c associated with three of the individual cabinets 19 are shown positioned horizontally adjacent to the connection cabinets 19. The top two storage units 21a and 21b are shown in the closed position within the rack 20 and the lower storage means 21c is shown in the open position where access to the pigtail overlength is facilitated.

In Figure 6 is shown schematically a plurality of optical cables 22 entering a plurality of stacked modules 23. Each module 23 comprises a connection cabinet 24 in which the cables 22 are connected to or spliced with a pigtail fibre 25 and a storage unit 26. The connected or spliced pigtail fibres 25 are shown exiting the connection cabinets 22 and entering the storage units 26 for the pigtail overlength, where they are shown

schematically stored in two substantially parallel planes. The pigtail fibres 25 subsequently exit via an outlet guide 27 into a shared passageway where the pigtails from all the connection and storage modules 23 are guided to their respective destinations.

CLAIMS

1. An optical fibre connection and storage system comprising a plurality of connection cabinets provided with means for the connection or splicing of a first plurality of fibres to a second plurality of fibres and a plurality of respective storage means for the storage of overlength of the second plurality of fibres, wherein each of the plurality of cabinets has associated with but separate from it one of the plurality of storage means, with each storage means being provided for the storage of the overlength of the second plurality of fibres from a single respective cabinet.

2. A connection and storage system according to Claim 1, wherein the second plurality of fibres is a plurality of pigtail fibres.

3. A connection and storage system according to Claim 1 or 2, wherein the storage means is provided with at least one guide member capable of organising the stored plurality of fibres.

4. A connection and storage system according to Claim 1, 2 or 3, wherein the storage means is provided with means for locating the stored fibres in three dimensions.

5. A connection and storage system according to Claim 4, wherein the locating means includes means for directing fibres located in a first plane away from that plane in a direction inclined to that plane.

6. A connection and storage system according to Claim 4 or 5, wherein the locating means is a fibre guide capable of supporting a plurality of fibres and shaped so as to be able to direct stored fibres away from a first plane to a second plane.

7. A connection and storage system according to any one of Claims 4, 5 or 6, wherein the locating means is movably mounted with respect to at least a part of the storage means.

8. A connection and storage system according to any preceding claim, wherein the storage means is movably mounted with respect to its respective cabinet.

9. A connection and storage system according to any preceding claim, wherein a connection cabinet is provided with a plurality of splice trays or connection trays and an individual storage means is provided for the fibre overlength from each splice tray or connector tray.

10. A module for use in a connection and storage system according to any preceding claim, which module comprises a connection cabinet provided with means for the connection or splicing of a first plurality of fibres to a second plurality of fibres and an integrated storage unit for the separate storage of overlength of the second plurality of fibres.

11. A storage unit for use in a connection and storage system according to any one of Claims 1 to 9 or in a module according to Claim 10.

12. A connection and storage system substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

* * * * * * *

Fig.1.

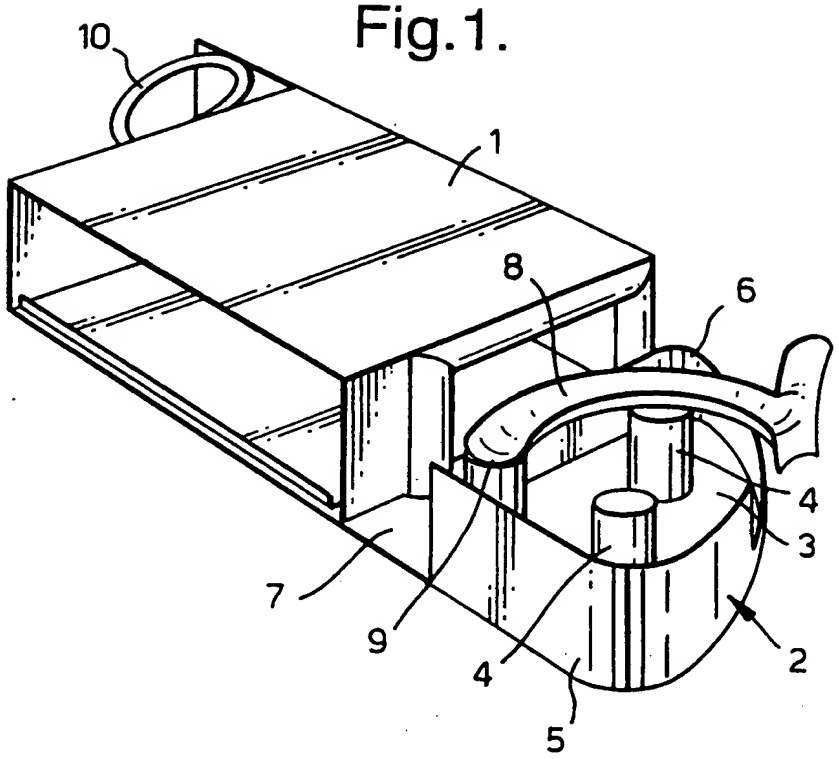


Fig.2.

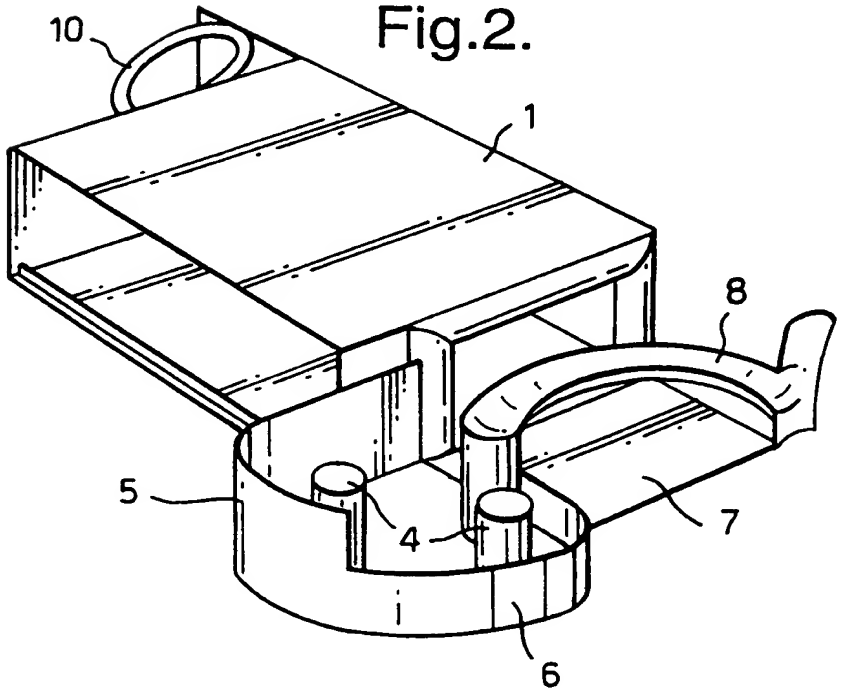


Fig.3.

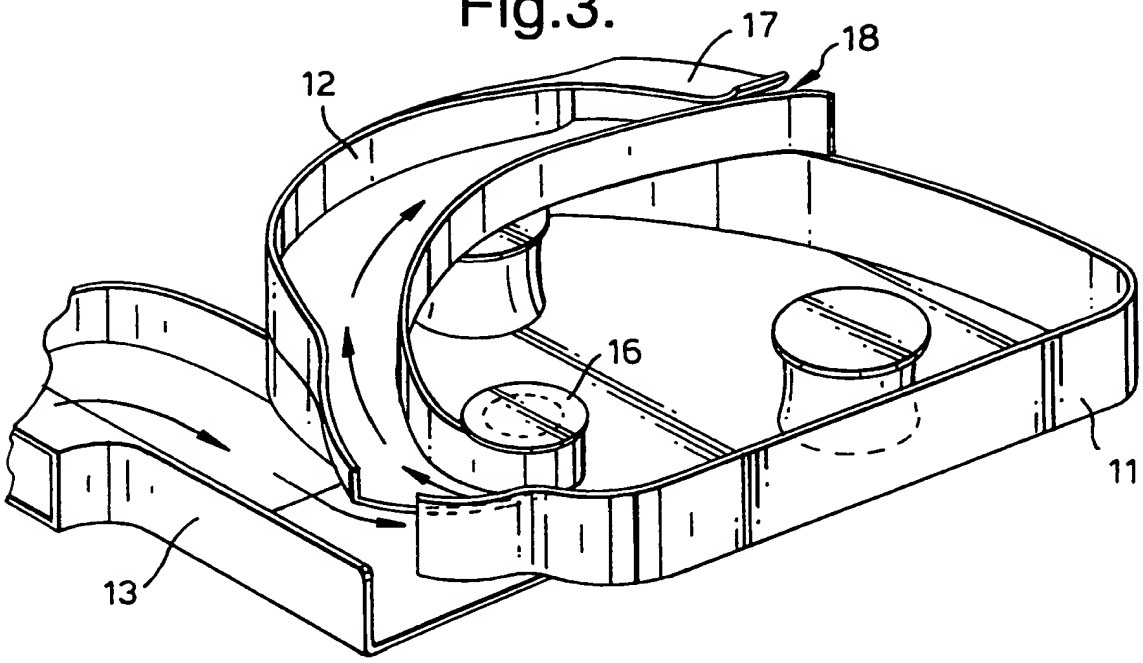


Fig.5.

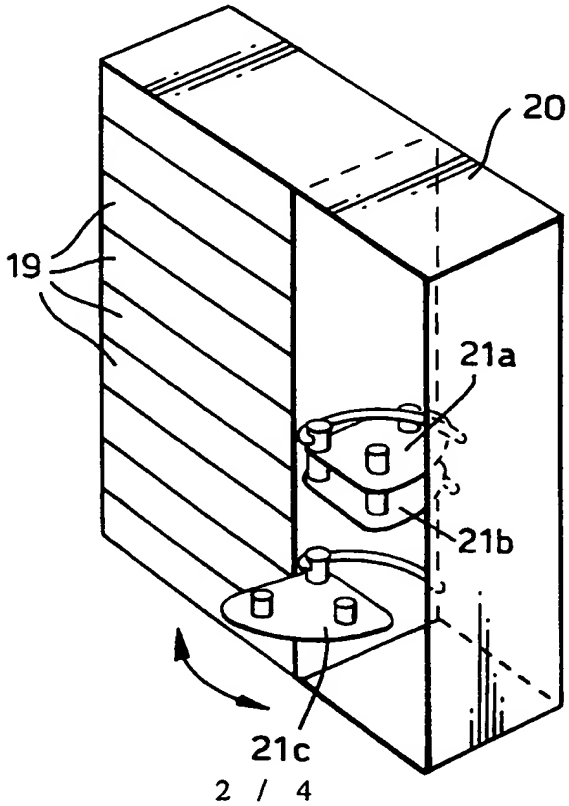


Fig.4.

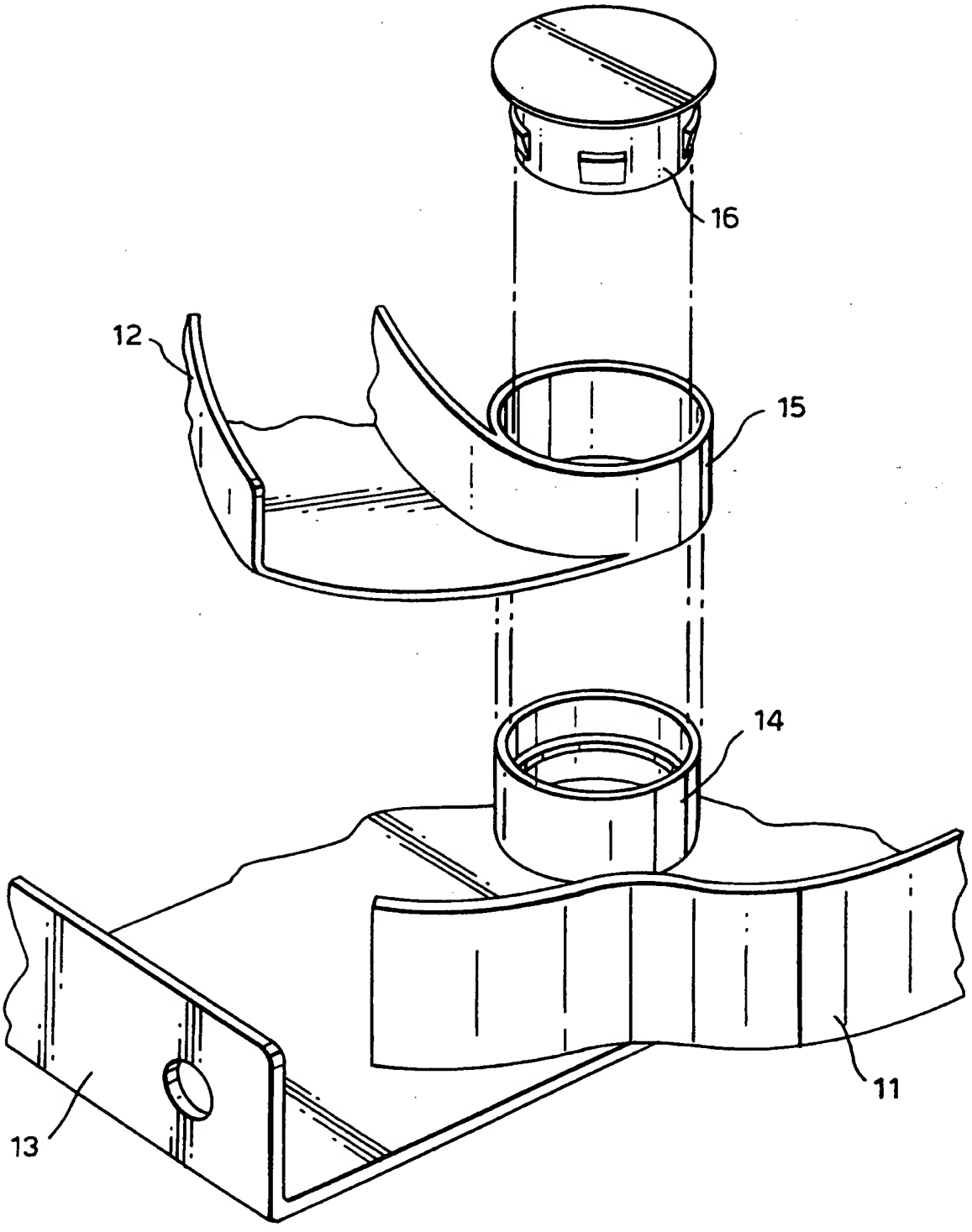
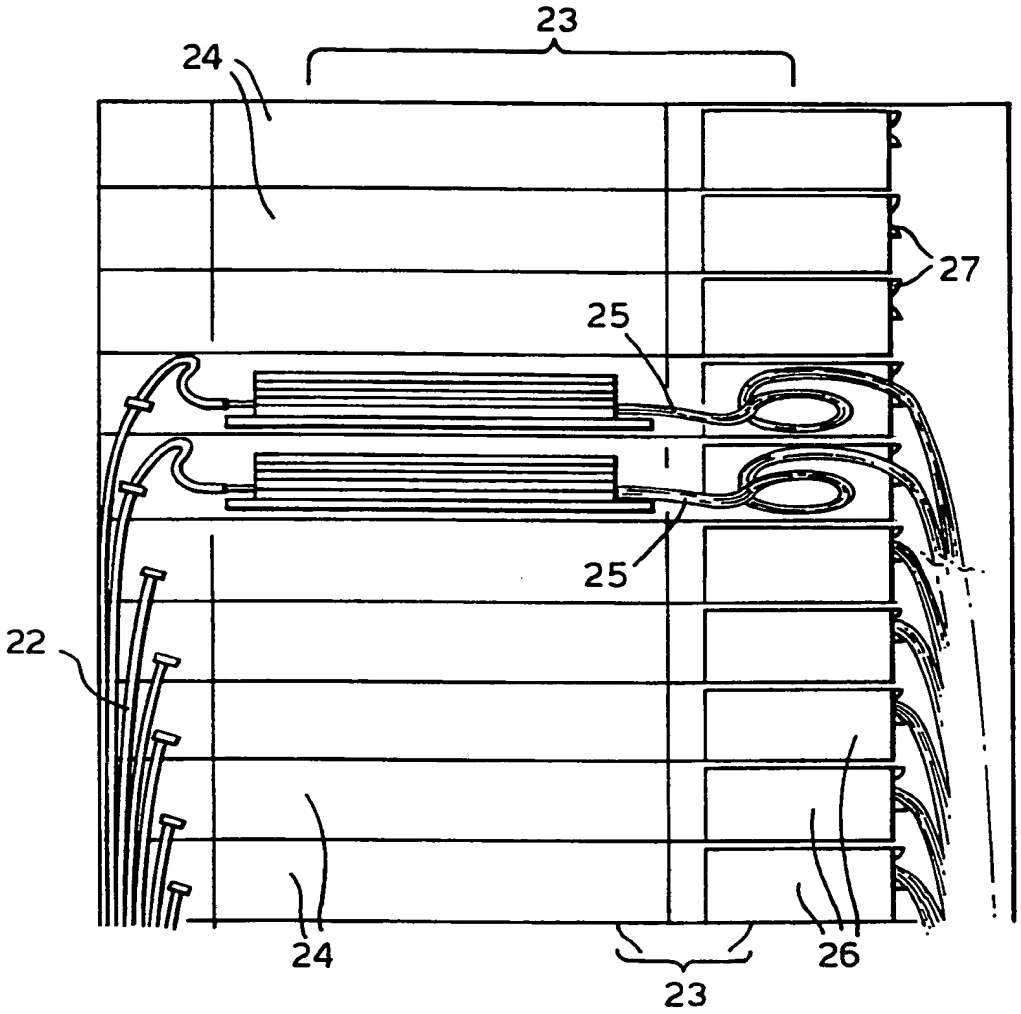


Fig.6.



INTERNATIONAL SEARCH REPORT

Int. ..ional Application No
PCT/GB 99/00643

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G02B6/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 215 668 A (ADC TELECOMMUNICATIONS INC) 25 March 1987	1,2,8-10
A	see claims; figures	3-5,7
A	US 5 100 221 A (CARNEY WILLIAM V ET AL) 31 March 1992 see claims; figures	1
A	US 5 640 482 A (BARRY BRUCE ELTRINGHAM ET AL) 17 June 1997 see claims; figures	1
A	US 5 353 367 A (CZOSNOWSKI W MICHAL ET AL) 4 October 1994 see claims; figures	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 May 1999	07/06/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Pfahler, R

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte. ional Application No
PCT/GB 99/00643

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0215668 A	25-03-1987	AT 59237 T	15-01-1991
		AU 6272886 A	19-03-1987
		CA 1275193 A	16-10-1990
		JP 62112106 A	23-05-1987
		US 4792203 A	20-12-1988
US 5100221 A	31-03-1992	AU 7324891 A	05-08-1991
		CA 2074353 A	23-07-1991
		CZ 9202185 A	18-05-1994
		CZ 9202186 A	18-05-1994
		EP 0512067 A	11-11-1992
		HU 62096 A	29-03-1993
		JP 5503592 T	10-06-1993
		WO 9110927 A	25-07-1991
		US 5142606 A	25-08-1992
US 5640482 A	17-06-1997	NONE	
US 5353367 A	04-10-1994	NONE	